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TRANSITION FROM A WAVEGUIDE TO A MICROSTRIP

BACKGROUND OF THE INVENTION

1. Field of the invention.

The invention relates to a transition from a waveguide to a microstrip, and more particularly, to a microstrip extending, on a substrate, projecting through an opening into a waveguide and a ground line associated therewith.

2. Description of the related art.

A transition from a waveguide to a microstrip is known from U.S. 5,202,648. Wherein, a microstrip is extended on an upper side of a substrate and an associated ground line, consisting of a conductive surface on an opposite side of the substrate, contacts the waveguide wall. A problem is that a waveguide and a contact strip designed in this way has a reflection attenuation that is frequently too low and a transmission attenuation which is too high.

What is needed in the art is a transition, which has the highest possible reflection attenuation and the lowest possible transmission attenuation.

SUMMARY OF THE INVENTION

A ground line associated with a microstrip includes a plurality of ground surfaces superimposed on one another all of which contact one another by way of through-contacts in a substrate. The multi-layer ground line produces a more favorable field conversion from the microstrip to the waveguide, thereby a high reflection attenuation and a low transmission attenuation results.

A through-plating is provided in the substrate at the end of the microstrip which acts as an antenna and which projects into the waveguide, thus transition bandwidth is enlarged.

To make a good contact between the multi-layer ground line and the waveguide wall, it is expedient for ground surfaces to be applied to the substrate on both sides thereof, next to the

microstrip and for these ground surfaces to be in contact with the ground surfaces, that are superimposed on one another in the substrate via through-contacts (vias). Advantageously, the substrate is fixed, by at least one screw, on a support, on the waveguide wall. The screw is guided through the ground surfaces to the support and electrical contact is made between the ground surfaces and the support.

A low transmission attenuation is achieved by way of the at least one screw having its head on one of the ground surfaces, which is applied to the upper side of the substrate, next to the microstrip and by way of a conductive ribbon that is connected to the waveguide wall, the conductive ribbon being clamped between the screw head and the ground surface. Alternatively, at least one conductive elastic body is inserted between one of the two ground surfaces located to each side of the microstrip and a projection of the waveguide wall projecting over the ground surfaces. Further, a conductive elastic body can be pressed between the head of the at least one screw and the projection of the waveguide wall.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective illustration of a transition from a waveguide to a microstrip;

Fig. 2 is a longitudinal section A-A through the transition; and

Fig. 3 is a cross-section B-B through the transition.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate one preferred embodiment of the invention,

in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and more particularly to Fig. 1, there is illustrated a microstrip 2 on a multi-layer substrate 1. Opening 4 is located in a side wall of waveguide 3 and tongue 5, of substrate 1, projects into waveguide 3. The portion of microstrip 2 which extends on tongue 5 is antenna 6 which couples a waveguide field to microstrip 2 and/or vice versa.

Now, additionally referring to Figs. 2 and 3 there is shown two ground surfaces 7 and 8, which are applied to the upper side of substrate 1 next to microstrip 2. A plurality of ground surfaces 9 are superimposed on one another within multi-layer substrate 1 each having the same ground potential. Cross-section B-B, through waveguide 3 into substrate 1, shown in Fig. 3 shows multi-layer ground surfaces 9 within substrate 1.

Longitudinal section A-A, shown in Fig. 2, shows two symmetrical ground surfaces 7 and 8, respectively, along each side of microstrip 2. Ground surfaces 7 and 8, on the upper side of substrate 1, are connected in an electrically conductive manner by a plurality of through-contacts 10 to other ground surfaces 9, which are superimposed on one another within substrate 1. The position and spacing of through-contacts 10 are selected such that a field propagation, into the intermediate areas between the ground surfaces of multi-layer substrate 1, is prevented since the function of circuits arranged in individual substrate layers, are thereby interfered with.

Ground surfaces 9 of substrate 1, preferably project some tenths of a millimeter into waveguide 3, thereby increasing the positional tolerance of substrate 1 with respect to waveguide 3. The field configuration beneath microstrip 2 in waveguide 3 closely depends on the position of ground surfaces 9. If the position of substrate 1 is slightly changed the field remains unchanged due to the positional tolerance of ground surfaces 9. At an operational frequency of,

for example, 10 GHz, a penetration depth of ground surfaces 9 into waveguide 3 of 0.5 - 1.0 mm is appropriate.

Multi-layer substrate 1 forms a large virtual ground, whereby a field configuration arises which is better transformed into a waveguide wave. The field is shaped more intensely into a field component of the fundamental wave type of waveguide 3 by the larger expansion of the ground (due to the many ground surfaces 9 stacked on top of one another) in the direction of the broad side of waveguide 3.

It can be seen from Figs. 2 and 3 that a through-plating 11 is provided at the end of antenna 6 of microstrip 2 extending on substrate tongue 5. Through-plating 11 at the end of antenna 6 of microstrip 2 results in a broadening of the frequency band of the transition from waveguide 3 to microstrip 2. Through-plating 11, at the end of antenna 6, is large due to the thicker design of substrate 1, which contributes to a more favorable conversion of the microstrip field into the waveguide field.

Substrate 1 is fixed to support 14 beneath opening 4 by at least one screw; there being two screws 12 and 13 in the embodiment shown in Fig. 2. Screws 12 and 13 lie with their heads on ground surfaces 7 and 8 next to microstrip 2 and screws 12 and 13 make an electrical contact between ground surfaces 7 and 8 and ground surfaces 9 superimposed on one another in substrate 1 and waveguide wall 14. Since electrical contact is additionally made between ground lines 7 and 8, applied to the upper side of substrate 1, and waveguide wall 14, the transmission attenuation of the transition is reduced. This contact can, as shown in Fig. 2, be made by two conductive ribbons 15 and 16, which are clamped at one end between the heads of screws 12 and 13 and conductive surfaces 7 and 8 and at their other end in parting plane 17 of waveguide 3, including two half shells.

Fig. 3 shows another variant for effecting the electrical contact of ground surfaces 7 and 8, and screws 12 and 13, with waveguide wall 14. Waveguide 3 has a wall projection 18 above opening 4 which projects over ground surfaces 7 and 8 on the upper side of substrate 1. One or more conductive elastic bodies 19 are clamped between ground surfaces 7 and 8 on the upper side of substrate 1 and wall projection 18. One or more conductive elastic bodies 20 can also be pressed between the heads of screws 12 and 13 and wall projection 18.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.